



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: SOMERVILLE, Robin B.; FAN, Liang-Tseng

SERIAL NO.: 10/089,896

ART UNIT: 1764

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EXAMINER: Johnson, J.D.

TITLE: PROCESS FOR MODIFYING COAL SO AS TO REDUCE SULFUR EMISSIONS

Supplemental AMENDMENT "A"

Director of the U.S. Patent  
and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

In response to the Office Action of March 17, 2004, having a response being due by June 17, 2004, and in response to an advisory communication of a non-compliant amendment, please consider the following remarks:

REMARKS

Applicant respectfully submits the present Supplemental Amendment "A" in a revised format in response to the Notice of Non-Compliant Amendment of June 29, 2004. The Examiner indicated that the format of the Amendment should comply with 37 C.F.R. § 1.121(b)(1). Applicant respectfully contends that the present amendment is now in compliance with the required amendment practice, including amendment sections on separate pages. This new format of Supplemental Amendment "A" is now in the proper condition for consideration. Furthermore, the present supplemental amendment has been filed before expiration of the shortened statutory period for response such that a fee for extension of time is not currently due.

Upon entry of the present amendments, previous Claims 1 - 20 have been canceled and new Claims 21 - 39 substituted therefor. Reconsideration of the rejections, in light of the forgoing amendments and present remarks, is respectfully requested. The present amendments have been entered for the purpose of distinguishing the present invention from the prior art.

In the Official Action, it was indicated that Claims 1 - 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Smith patent. Additionally, the Examiner has minor objections under 35 U.S.C. § 112, second paragraph, with respect to the language of Claim 4.

As an overview to the present reply, Applicant has amended the independent claims of the present application in the form of new independent Claims 21 and 34. Each of these new Claims 21 and 34 now recite the limitation of "fresh" hydrated lime. Independent Claim 21 recites that the "fresh hydrated lime being unexposed to atmospheric carbon dioxide". Independent Claim 34 indicates that the steps of grinding and blending and adding water and heating are in a "continuous process".

The importance of "fresh hydrated lime" was described in the original specification in paragraph [0021] on page 7, as follows:

As can be seen from these test results, the process of the present invention treats high-sulfur coal with the fresh hydrated lime  $[\text{Ca}(\text{OH})_2]$  so that sulfur emission from the combustion of the coal can be reduced by up to 90%. Combustion of the treated coal generates less ash than that of untreated coal with sulfur-removal by a conventional lime ( $\text{CaO}$ ) scrubbing system. The characteristics of the product of the process of the present invention are attributable to the fact that the fresh hydrated lime, yet to be exposed to carbon dioxide ( $\text{CO}_2$ ) in the atmosphere to any appreciable extent, is far more reactive with sulfur in coal than unhydrated lime ( $\text{CaO}$ ). Moreover, the ash of the treated coal of the process of the present invention has a lower pH than ash from conventional combustion and is of good

quality. As a result, it makes the ash ideal for marketing rather than disposal.

As such, the important distinguishing characteristic of the present invention is the use of the “fresh” hydrated lime.

The prior art Smith patent teaches the use of calcium hydroxide, i.e. hydrated lime. However, the Smith patent does not specifically teach the use of “fresh” hydrated lime or “fresh” calcium hydroxide. In fact, many of the practices taught in the Smith patent inevitably lead to the prolonged exposure of the calcium hydroxide to the atmosphere. As was stated in column 1, lines 13 - 18, of the Smith patent:

In another aspect, this invention relates to a method for preparing coal or lignite, which contains sulfur, for combustion with reduced emissions of contaminants whereby the prepared fuel can be shipped, stored and used in conventional equipment.

This advantages of transportability and storing was additionally recited in the Abstract of the Smith patent and in column 2, lines 25 - 49 of the Smith patent. Each of these practices of transportation and storage will inevitably lead to prolonged exposure of the calcium hydroxide to atmospheric carbon dioxide.

In the present invention, the modified coal is prepared by agglomerating the finely divided coal with the fresh hydrated lime powder “onsite” in enclosed vessels, immediately prior to the injection into the combustion chambers (as indicated in Figure 1 of the original specification). This will minimize the exposure of the fresh hydrate lime powder to carbon dioxide in the atmosphere. This will also minimize the potential danger of dust explosions. In contrast, in the Smith patent, the pellets of modified coal are prepared off-site. This will require the storage, transfer and transportation of the pellets of the modified coal. This profoundly magnifies the exposure of the

hydrate lime in the pellets to carbon dioxide in the atmosphere and also increases the probability of dust explosions. On this basis, Applicant respectfully contends that independent Claim 21 is patentably distinguishable from the Smith patent.

Relative to independent Claim 34, it is important to note that the process of the present invention utilizes a series of steps in a single system which can be operated continuously and can be contained in the same plant housing as that of the combustion chamber or boiler. These steps involve in a continuous sequence, the grinding of only the coal, the blending with the powder of fresh hydrated lime, accompanied by the agglomeration with proper adjustment of the moisture level. The blended powder is dried to the desired moisture content for application. Finally, there is immediate injection into the combustion chamber. As a result, the process of the present invention implies that no storage space is required.

The Smith patent describes a system which has structural and operational complexities far greater than that of the present invention. Various steps in manufacture and application are dispersed and distributed. Substantial storage spaces are required between manufacture and application. Consequently, the cost and expenses of implementing and operating the process of the Smith patent would be far greater than that of the present invention. Additionally, the oxides and hydroxides, including calcium hydroxide, would not remain fresh because of the repeated and prolonged exposures to the atmosphere. This results in the absorption by the calcium hydroxide of atmospheric carbon dioxide.

In the present invention, the fresh calcium hydroxide (lime) in the form of a powder is readily available in the market in impervious, air-tight containers. It is supplied directly to the process from such containers and remains in the processing vessels. Upon completion of processing, it is

immediately injected into the combustion chamber. As a result, it practically experiences no exposure to the atmospheric carbon dioxide and remains essentially fresh. In contrast, the Smith patent describes a multi-state and multi-step process, involving off-site grinding, blending, pelletization to larger particles or formation into briquettes. This is repeatedly mentioned in the description of the preferred embodiments of the Smith patent.

In the present invention, the proper adjustment of moisture content is achieved through the addition or removal of water. As a result, lime itself serves as the binder. The binders used in the Smith patent are lignin, coal tar pitch and petroleum pitch (see, e.g. column 5 of the Smith patent). These binders will tend to contain some sulfur which is obviously undesirable. Moreover, any of these binders are far more costly and difficult to handle, as well as more expensive to supply and apply, than the binder used in the present invention. The binder in the present invention is solely lime itself.

The present application teaches the blending of fresh hydrated lime in the form of finely divided dry powder with coal particles followed by the addition or removal of water in order to adjust the moisture level of the blended mixture, and then drying. This makes it possible to maintain the consistency and reactivity of the blended product. In contrast, the Smith patent teaches the formation of a slurry of the finely divided material in a suitable carrier, such as water, followed by spraying the slurry onto the surface of coal. This practice gives rise to the complexity of operation and quality control.

On this basis, Applicant respectfully contends that independent Claims 21 and 34, as amended, are patentably distinguishable from the prior art Smith patent. Fundamentally, the

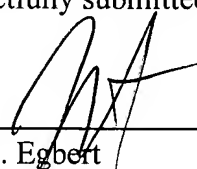
enhanced reactivity of the fresh hydrated lime will tend to remove the sulfur in the coal at a far greater rate than the use of unhydrated lime.

Applicant has included original Claims 2 and 3 in the form of new Claims 22 and 23, respectively. Original Claim 4 has been canceled in view of the Examiner's objection. Original Claims 5 - 14 appear herein in the form of new Claims 24 - 33. Original dependent Claims 16 - 20 appear herein in the form of new dependent Claims 35 - 39, respectively.

Based upon the foregoing analysis, Applicant contends that independent Claims 21 and 34 are now in proper condition for allowance. Additionally, those claims which are dependent upon these independent claims should also be in condition for allowance. Reconsideration of the rejections and allowance of the claims at an early date is earnestly solicited. Since no new claims have been added above those originally paid for, no additional fee is required.

Respectfully submitted,

7.8.04  
Date

  
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John S. Egbert  
Reg. No. 30,627  
Andrew W. Chu  
Reg. No. 46,625  
Attorney for Applicant  
Harrison & Egbert  
412 Main Street, 7<sup>th</sup> Floor  
Houston, Texas 77002  
(713)224-8080  
(713)223-4873 fax